MARAIS DES CYGNES RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Water Body: Hillsdale Lake
Water Quality Impairment: Eutrophication

Subbasin: Lower Marais des Cygnes

County: Johnson, Miami, Franklin, and Douglas

HUC 8: 10290102

HUC 11 (HUC 14)**:** **010** (010, 020, 030)

Drainage Area: Approximately 142.2 square miles.

Conservation Pool: Area = 4,576 acres, Maximum Depth = 13 meters

Designated Uses: Primary and Secondary Contact Recreation; Special Aquatic Life Support; Drinking Water; Industrial Water Supply Use; Food Procurement

1998 303d Listing: Table 4 - Water Quality Limited Lakes

Impaired Use: All uses are impaired to a degree by eutrophication

Water Quality Standard: Nutrients - Narrative: The introduction of plant nutrients into streams, lakes, or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life. (KAR 28-16-28e(c)(2)(B)).

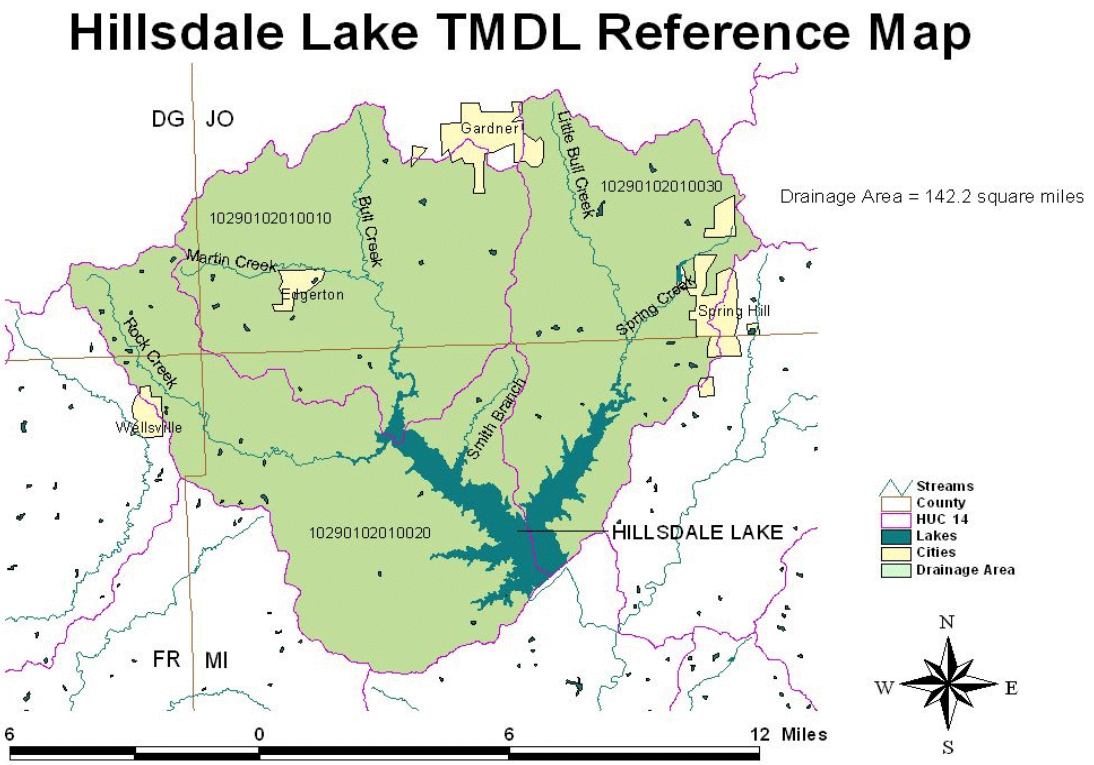
The introduction of plant nutrients into surface waters designated for primary or secondary contact recreational use shall be controlled to prevent the development of objectionable concentrations of algae or algal by-products or nuisance growths of submersed, floating, or emergent aquatic vegetation. (KAR 28-16-28e(c)(7)(A)).

2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

Level of Eutrophication: Fully Eutrophic, Trophic State Index = 58.85

Monitoring Sites: Stations 035001 (Dam), 035002 (Big Bull Arm), and 035003 (Little Bull Arm) in Hillsdale Lake (Figure 1).

Figure 1



Period of Record Used: Twelve surveys during 1987-2000.
Special 319 Project: US Army Corps of Engineers data (1993-2000)

Current Condition:
The Trophic State Index is derived from the chlorophyll a concentration. Trophic state assessments of potential algal productivity were made based on chlorophyll a concentrations, nutrient levels and values of the Carlson Trophic State Index (TSI). Generally, some degree of eutrophic conditions is seen with chlorophyll a concentrations over 7 ug/l, and hypereutrophy occurs at levels over 30 ug/l. The Carlson TSI, derives from the chlorophyll concentrations and scales the trophic state as follows:

1. Oligotrophic	TSI < 40
2. Mesotrophic	TSI: 40 - 49.99
3. Slightly Eutrophic	TSI: 50 - 54.99
4. Fully Eutrophic	TSI: 55 - 59.99
5. Very Eutrophic	TSI: 60 - 63.99
6. Hypereutrophic	TSI: $ 64

Phosphorus is indicated to be the primary limiting factor. For the whole lake, the total nitrogen to total phosphorus ratio is 17.8. (TN/TP ratios greater than 12 indicate that phosphorus is limiting). The largest portion of the lake, represented by the station near the dam, has a ratio greater than 23.

Overall, the total phosphorus load is greatest to the Big Bull Arm of the lake (See Appendix B for all graphs). Algal growth is highest in the section of the lake with the largest nutrient load. The Big Bull Arm of Hillsdale Lake has a Trophic State Index of 62.42 (calculated from KDHE data) indicating very eutrophic conditions. According to modeling done by Kansas State University and the Hillsdale Water Quality Project, Big Bull Creek contributes 40 - 50% of the nonpoint source pollutants while Little Bull Creek contributes only 25% of the nonpoint source pollutants.

Average and Range of Total Phosphorus and Chlorophyl a Concentrations in Hillsdale Lake.

	KS Department of Health and Environment		**US Army Corps of Engineers**	
	Total Phosphorus (ug/L)	Chlorophyl a (mg/L)	Total Phosphorus (ug/L)	Chlorophyl a (mg/L)
Whole Lake	48.6 (10.0 - 240.0)	17.9 (2.6 - 93.2)	52.2 (10.0 - 190.0)	11.9 (0.2* - 55.7)
Big Bull Arm	50.5 (10.0 - 120.0)	25.7 (9.0 - 93.2)	71.6 (40.0 - 190.0)	13.0 (0.9* - 45.6)
Little Bull Arm	34.2 (10.0 - 130.0)	15.9 (5.8 - 33.4)	50.3 (20.0 - 122.0)	12.6 (0.9* - 55.7)
Near Dam	56.9 (10.0 - 240.0)	12.0 (2.6 - 22.2)	33.8 (10.0 - 110.0)	10.1 (0.2* - 38.1)

* The chlorophyll data from 1996 are consistently low and may not represent conditions within the lake. (Jones 1998)

Secchi disc depth is an indicator of water clarity. Algal production will decrease with a reduction of the phosphorus load. With less chlorophyl a in the water column, the clarity of the water will improve and thus greater Secchi disc depth readings will be seen. The Secchi disc depth averages 1.04 meters for the whole lake. The clarity is best at the dam (average depth of 1.31 m). Removing the samples taken after storm events, the average Secchi disc depth is 1.47 m. The Secchi disc depth is shortest in the Big Bull Creek arm (0.81 m; 0.86 m for dry weather samples) of the lake because of higher turbidity levels and higher concentrations of algae as compared to the rest of the lake. The Little Bull Creek Arm averages 0.98m.

Interim Endpoints of Water Quality (Implied Load Capacity) at Hillsdale Lake over 2006 - 2010:

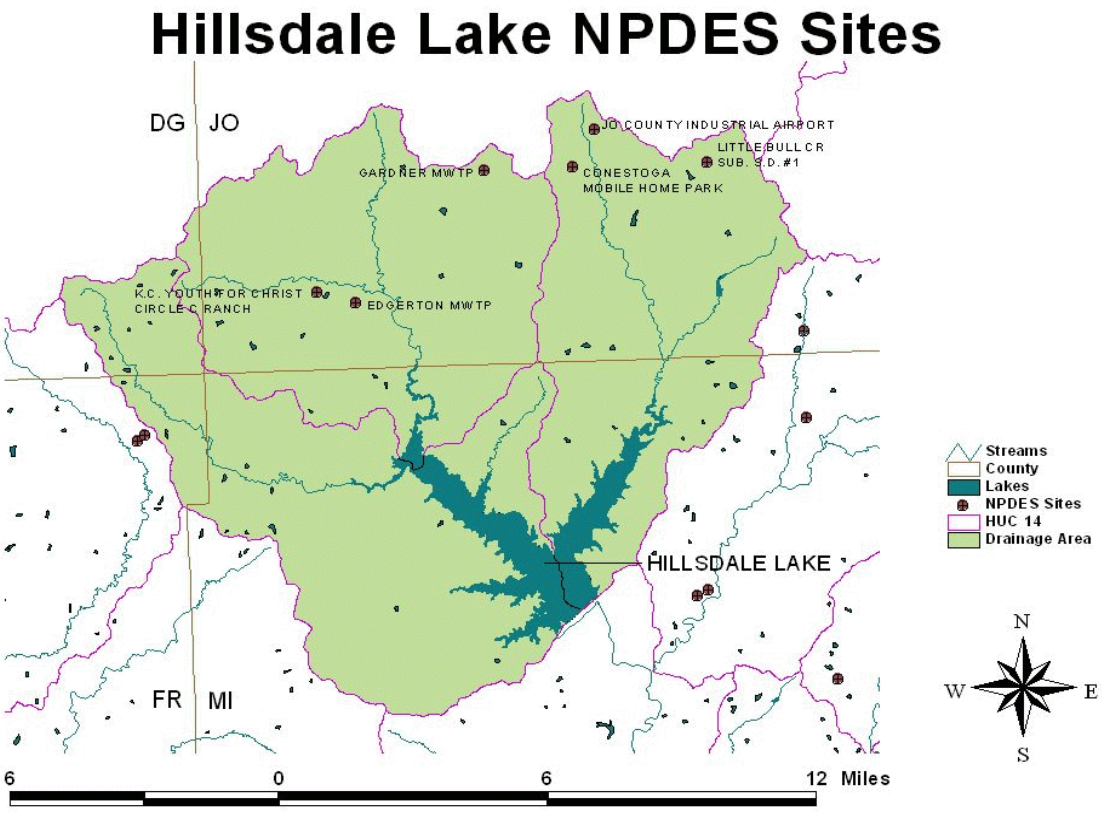
In order to improve the trophic condition of the lake from its current fully eutrophic status, the desired endpoint will be summer chlorophyll a concentrations at or below 12 ug/l, corresponding to a trophic state indicative of slightly eutrophic conditions, by 2010. To ensure the clarity of the water, the desired Secchi disc depth endpoint will be summer average readings greater than 1 m in the two arms of the lake and 1.5 m in the main body of the lake near the dam. Both the chlorophyl a and Secchi disc depth endpoints must be met in order to comply with the Water Quality Standards.

3. SOURCE INVENTORY AND ASSESSMENT

The watershed around Hillsdale Lake has a high potential for nonpoint source pollutants. Numerous studies have been done to determine the annual phosphorus load to Hillsdale Lake. Below is a summary of the most recent studies:

Source of Estimate	Period of Record Used	Mean Annual Load Estimate (lb/year)	Mean Annual Load Estimate (kg/year)
Kansas Department of Health and Environment	1985 - 2000	148,251	67,246
United States Geological Survey	1981 - 1996	154,322	70,000
Hillsdale Water Quality Project (refined method)	1994 - 1999	156,637	71,050
Baseline (Average of Estimates)		**153,070 lb/year**	**69,432 kg/year**

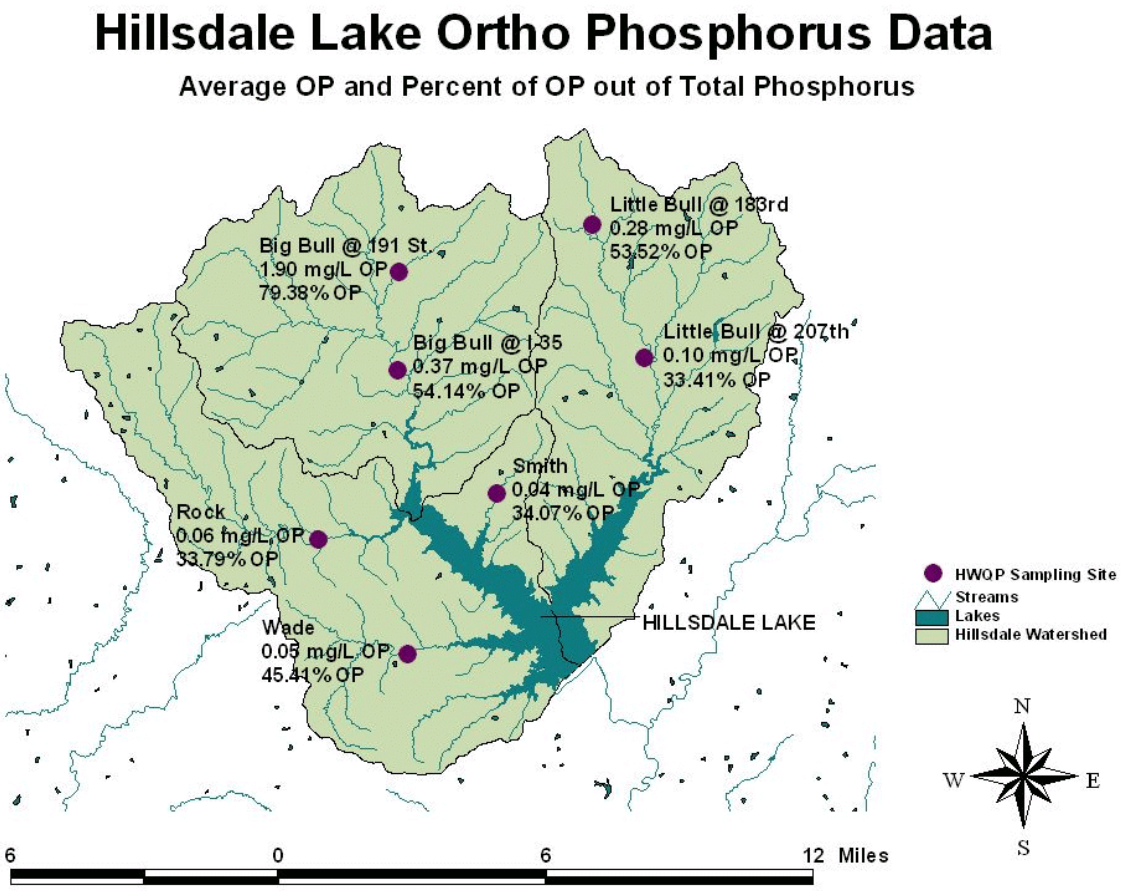
Figure 2



NPDES: Six NPDES and one KWPC permitted facilities are located within the watershed

(Figure 2). These point sources contribute an estimated 11.0% of total annual phosphorus loads. According to projections of future water use and resulting wastewater, the Gardner WTF (South) and Edgerton WTP look to have sufficient treatment capacity available. Lone Elm Estates (Little Bull Creek Suburban S.D. #1) is scheduled for abandonment and the waste will be transferred to New Century Air Center (Little Bull Creek Sewer Sub-District No. 2). The City of Gardner will be building a new waste treatment facility in addition to the two other facilities; this new facility has a design flow of 2.5 MGD and will discharge into Kill Creek, in the Kansas Lower-Republican Basin.

Figure 3



While they constitute 11.0% of **total** phosphorus load, point sources could potentially contribute as much as 38% of **available** phosphorus (ortho-phosphorus) under design flow conditions (Figure 3). The chemical form of phosphorus from point sources is more readily utilized by algae and other aquatic plants than phosphorus from nonpoint sources. Further analysis is needed to assess the fate of available phosphorus in transit along the stream prior to entry into Hillsdale Lake.

Point Sources Located in the Hillsdale Lake Watershed

Name	Stream	Facility Description	Design Flow	Expiration Date
Gardner WTF (South)	Unnamed Tributary to Big Bull Creek	Trickling Filter System	0.988 MGD	2004
Gardner WTF (temporary)	Unnamed Tributary to Big Bull Creek	Activated Sludge	0.288 MGD	2003
Edgerton WTP	Martin Creek to Big Bull Creek	Activated Sludge, Oxidation Ditch	0.18 MGD	2004
Conestoga Mobile Home Park WTF	Little Bull Creek	Two-Cell Lagoon System	0.03 MGD	2004
New Century Air Center	Little Bull Creek	Activated Sludge	0.54 MGD	2004
Circle C Ranch	Non-discharging	Two-Cell Lagoon System	0.011 MGD	2005
Lone Elm Estates	Little Bull Creek via Bain Creek	Three-Cell Aerated Lagoon System	0.122 MGD	2004

Table 1 presents the current condition of actual average flow and actual average effluent phosphorus concentration. All total phosphorus samples from the past year were averaged. The flows, from the same day that the phosphorus samples were taken, were averaged.

Table 1. Current Phosphorus Load from Point Sources

Name	Year	Average Flow (MGD)	Average Phosphorus (mg/L)	Load (lb/day)
Gardner WTF (South)	Dec '99- Nov '00	1.00	4.90	41.01
Gardner WTF (temporary)	Expected Discharge	0.288	1.50	*3.61
Conestoga Mobile Home Park WTF	Dec '99-Dec '00	0.04	2.37	0.69
Edgerton WTP	Jan '00 - Dec '00	0.12	2.78	2.69
Circle C Ranch	N/A		No Data	Non-discharging
New Century Air Center	Jan '99 - Dec '99	0.37	0.47	1.43
Lone Elm Estates	Jan '99 - Dec '99	0.04	1.34	0.47
			Total (lb/day)	**46.30**

* Now in construction, not included in total

The Gardner WTF (South) and Conestoga WTF discharge an average flow in excess of the permitted design flow, and the other three discharge average daily flows far less than the permitted design flow. Therefore, the discharge of phosphorus is “weighted” to reflect the permitted design flow, as shown in Table 2.

The New Century Air Center and Lone Elm Estates will be combined into one NPDES permit; the total phosphorus load identified in the permit was used. For the other facilities, the phosphorus concentration was weighted to represent the total phosphorus concentration under

design flow conditions. If the point source normally operates below design flow, then the average total phosphorus concentration was proportionally elevated to represent the design flow condition. The results of these calculations will be considered the baseline of the point source contributions; they are outline below.

Table 2 Estimated Phosphorus Load from Point Sources under Permitted, Design Flow Conditions

Name	Design Flow (MGD)	Weighted Avg P (mg/L)	Load (lb/day)
Gardner WTF (South)	0.988	4.823	39.792
Gardner WTF (temporary)	0.288	1.500	^3.607
Conestoga Mobile Home Park WTF	0.030	2.027	0.508
Edgerton WTP	0.180	4.329	6.506
Circle C Ranch	0.011	Non-discharging	N/A
New Century Air Center combined with Lone Elm Estates	0.540 & 0.122	N/A	*10.400
			Total (lb/day) 57.206

* Permitted Load

^ Now in construction, not included in total

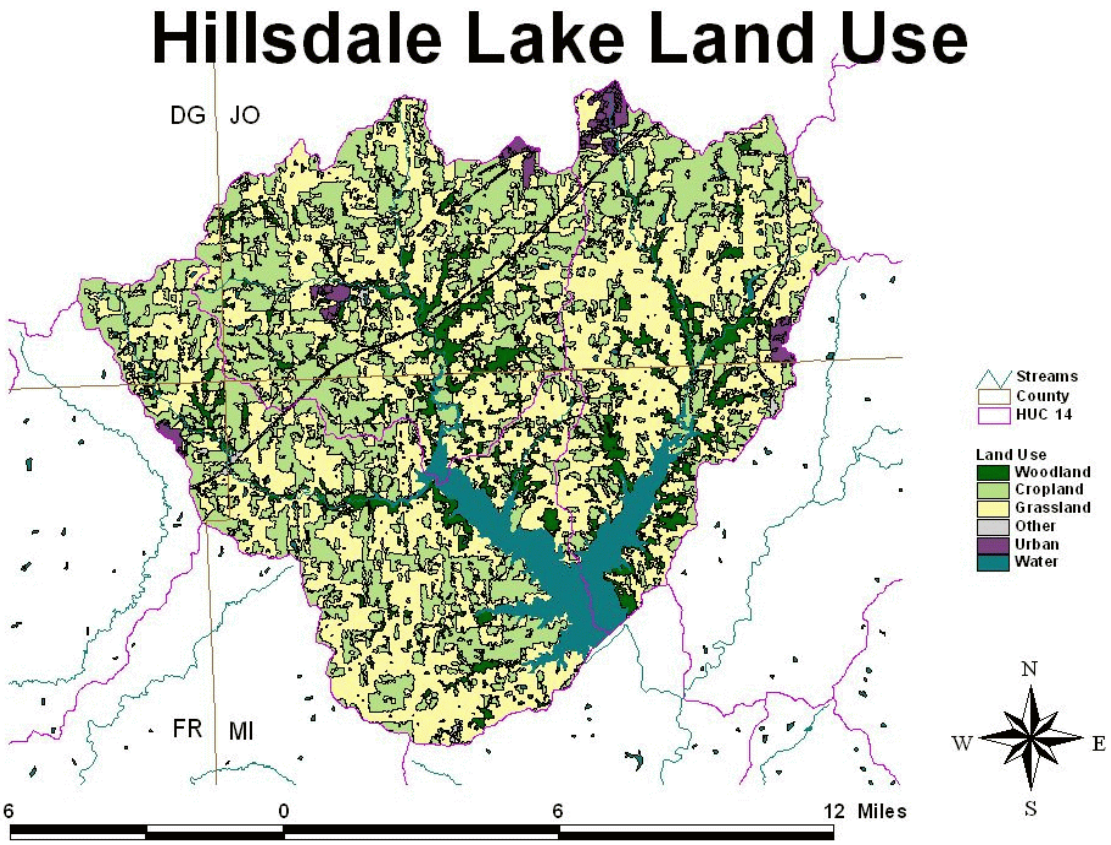
Current Condition using Permitted, Design Flow Conditions

	Load (kg/year)	Load (lb/year)	Percent
Baseline	69,432.00	153,069.79	
Point source	9,471.26	20,880.34	13.6%
Nonpoint	59,960.74	132,189.45	86.4%

Land Use: One source of phosphorus within Hillsdale Lake is runoff from agricultural lands where phosphorus has been applied. Land use coverage analysis indicates that 35.1% of the watershed is cropland (Figure 4). In 1999, the total amount of fertilizer containing phosphorus sold in the watershed was as follows:

	Tons of Fertilizer Bought in County	Percent of County within Watershed	Tons of Fertilizer Bought in County and within Watershed
Douglas	1,815 tons/year	1.7%	30.86 tons/year
Johnson	1,532 tons/year	13.6%	208.35 tons/year
Miami	2,006 tons/year	11.5%	230.69 tons/year
Franklin	1,891 tons/year	0.6%	11.35 tons/year
Total			**481.25** tons/year

Figure 4



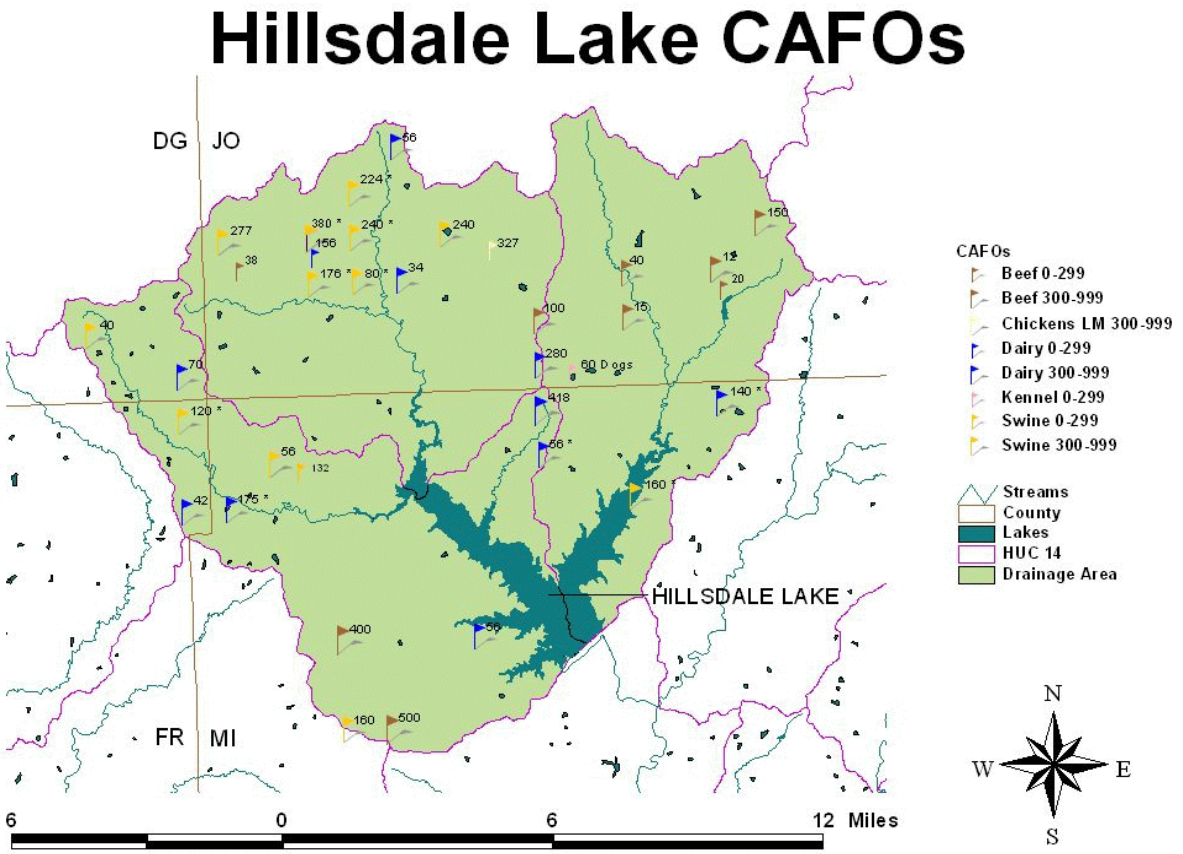
Phosphorus from animal waste is a contributing factor. Fifty percent of land around the lake is grassland; the grazing density of livestock is moderate. Animal waste applied to land, from confined animal feeding operations, adds to the nitrogen and phosphorus load going into Hillsdale Lake. There are 12 dairy, 9 beef, 1 chicken, 1 kennel, and 12 swine animal feeding operations in the watershed (Figure 5). Potential animal units for all facilities in the watershed total 5,370 (3,292 animal units from active facilities, and 2,078 animal units from inactive facilities). The actual number of animal units on site is variable, but typically less than potential numbers. Small horse farms are located in the watershed and may contribute to the phosphorus load. Pet waste is an additional factor.

Fertilizer applications to lawns and golf courses within the drainage and stormwater delivery to the lake are probable loading sources. The land use analysis preformed in 1993 indicated that two percent of the watershed is urban. The watershed is experiencing rapid urban sprawl, and thus urban pollutants will become an increasingly important issue over time. The populations of Gardner, Spring Hill, Edgerton, and Wellsville are expected to grow 94%, 26%, 20%, and 15% respectively through 2020. The drinking water use and the point source load will increase as the population

enlarges: the population increases will mean a greater dependence on the lake for water and greater amounts of waste will require treatment. (The City of Edgerton will be obtaining drinking water from Clinton Lake). Failing septic systems can be a significant source of nutrients. The following number of septic systems is present within the watershed:

County	Approximate Number of Septic Systems
Douglas	103
Franklin	30
Johnson	947
Miami	851

Figure 5



Contributing Runoff: The watershed's average soil permeability is 0.6 inches/hour according to NRCS STATSGO database. About 100% of the watershed produces runoff even under relatively low (1.5''/hr) potential rainfall conditions. Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.5"/hr of rain

will generate runoff from only 23.4% of this watershed, chiefly along the stream channels.

Background Levels: Eight percent of land in the watershed is woodland; leaf litter may be contributing to the nutrient loading. The atmospheric phosphorus and geological formations (i.e., soil and bedrock) may contribute to phosphorus loads.

4. ALLOCATION OF POLLUTANT REDUCTION RESPONSIBILITY

The general inventory of sources within the drainage does provide guidance as to areas of load reduction. Phosphorus is the limiting nutrient in Hillsdale Lake and allocated under this TMDL. A 46% phosphorus load reduction is required to meet the endpoints. This percentage was obtained from a CNET model. In addition, this load reduction should translate to about a 45% reduction in the number of days where phytoplankton are at nuisance levels, according to the CNET model. The Load Capacity (82,658 lb/yr) is equal to the baseline (153,070 lb/yr) minus the load reduction of 46% (70,412 lb/yr). (The baseline is computed at the beginning of the Source Inventory and Assessment section).

Load Capacity of Hillsdale Lake

	Load (lb/year)	**Load (kg/year)**	**Percent of LC**
Load Capacity (LC)*	**82,657.69**	**37,493.28**	
Waste Load Allocation (WLA)	**10,147.84**	**4,603.03**	**12.3%**
Load Allocation (LA)	**64,244.07**	**29,140.92**	**77.7%**
Margin of Safety (MOS)	**8,265.77**	**3,749.33**	**10.0%**

*LC = WLA + LA+MOS

Point Sources: This impairment is partially associated with NPDES sites. The relative contribution of each of these sites is tabulated in the Source Inventory and Assessment section. The Wasteload Allocation should be at 10,148 pounds per year, a decrease of 46% (with a 10% Margin of Safety) which should result in a decrease in available phosphorus needed to achieve the water quality goals. See Appendix A for details on the Waste Load Allocation.

Nonpoint Sources: Water quality violations are predominantly due to nonpoint source pollutants. Background levels may be attributed to nutrient recycling and leaf litter. The assessment suggests that urban growth, cropland, and animal waste contribute to the elevated phosphorus concentrations in the lake. A Load Allocation of 64,244 pounds per year, leading to a 46% reduction in available phosphorus (with a 10% Margin of Safety), is necessary to achieve the water quality goals for the lake.

Margin of Safety: The margin of safety provides some hedge against the uncertainty of variable annual total phosphorus loads and the chlorophyll a endpoint. Therefore, the margin of safety will be 8,266 pounds per year of total phosphorus taken from the load capacity subtracted to compensate for the lack of knowledge about the relationship between the allocated loadings and the resulting water quality.

State Water Plan Implementation Priority: Because Hillsdale Lake is a federal reservoir with a large regional benefit for recreation and water supply, this TMDL will be a High Priority for implementation.

Unified Watershed Assessment Priority Ranking: This watershed lies within the Lower Marais des Cygnes (HUC 8: 10290102) with a priority ranking of 12 (High Priority for restoration).

Priority HUC 11s: The watershed is within HUC 11 (010). The Big Bull Arm subwatershed (HUC 14: 010) will be high priority for implementation.

5. IMPLEMENTATION

Desired Implementation Activities

There is potential that agricultural best management practices and NPDES site upgrades will allow full use support to take place in Hillsdale Lake. Some of the recommended practices are as follows:

1. Implement soil sampling to recommend appropriate fertilizer applications on cropland.
2. Maintain conservation tillage and contour farming to minimize cropland erosion.
3. Maintain grass buffer strips along streams and install more buffer strips where needed.
4. Reduce activities within riparian areas.
5. Implement nutrient management plans to manage manure application to land.
6. Monitor and treat wastewater effluent for total and available phosphorus to reduce wasteloads within allocations.

Implementation Programs Guidance

NPDES and State Permits - KDHE

a. Monitor effluent from wastewater systems to continue to determine their nutrient contributions and ambient concentrations of receiving streams.

b. Ensure proper monitoring, permitting, and operations of municipal wastewater systems to limit nutrient and BOD discharges. Expand the scope of the projects for the Gardner WTF and the Edgerton WTF as required by the Schedule of Compliance in the NPDES permits to include the construction of phosphorus reduction equipment/processes.

c. In 2005, reassess current point source loadings and evaluate proposed, new dischargers and adjust wasteload allocations for 2006-2010.

d. Have wastewater systems discharge outside of the watershed if possible.

e. Livestock facilities over 300 animal units will continue to apply pollution prevention technologies as required by KDHE programs.

f. Livestock permitted facilities will be inspected for integrity of applied pollution prevention technologies.

g. Manure management plans will be implemented.

Stormwater Management - KDHE

a. Assist cities and Johnson County with evaluation of Best Management Practices which will lead to reduction in nutrient loading from urban settings during runoff into lake.

Nonpoint Source Pollution Technical Assistance - KDHE

a. Support Section 319 demonstration projects for reduction of sediment runoff from agricultural activities as well as nutrient management.

b. Provide technical assistance on practices geared to establishment of vegetative buffer strips.

c. Provide technical assistance on nutrient management in vicinity of streams.

d. Assist evaluation of stormwater quality from urbanized areas of watershed.

e. Provide technical assistance on practices, geared to small livestock operations, which minimize impact to lake resources.

f. Guide federal programs such as the Environmental Quality Improvement Program, which are dedicated to priority subbasins through the Unified Watershed Assessment, to priority watersheds and stream segments within those subbasins identified by this TMDL.

g. Compile and publish a compendium of sources for technical, financial, and educational assistance for use by delivery agents and landowners.

United States Geological Survey

a. Continue taking flow measurements on the Big Bull and Little Bull Creeks.

United States Army Corps of Engineers

a. Monitor Secchi disc depths within the lake and its arms during June through September.

Hillsdale Water Quality Project Inc.

a. Utilize existing GIS coverages (created by Kansas State University Extension) to identify and track land use changes that affect nonpoint source pollution loading in the watershed. This may include utilizing KSU's AGNPS model to estimate load reductions in the watershed.

b. Continue to focus information and education activities in high priority areas.

c. Provide technical and financial assistance on the installation of urban and agricultural best management practices.

Local Environmental Protection Program - KDHE

a. Inspect on-site waste systems within one mile of main tributary streams.

Fisheries Management - KDWP

a. Assist evaluation in-lake or near-lake potential sources of nutrients to lake.

b. Advise cities on application lake management techniques which may reduce nutrient loading and cycling in lake.

c. Take Secchi disc depth readings in the lake and its arms over June through September.

Water Resource Cost Share & Nonpoint Source Pollution Control Programs--SCC

a. Apply conservation farming practices, including terraces and waterways, sediment control basins, and constructed wetlands.

b. Provide sediment control practices to minimize erosion and sediment and nutrient transport.

c. Develop improved grazing management plans

d. Install livestock waste management systems for manure storage

e. Implement manure management plans

f. Install replacement on-site waste systems

g. Coordinate with USDA/NRCS Environmental Quality Improvement Program in providing educational, technical and financial assistance to agricultural producers.

Riparian Protection Program - SCC

a. Establish or reestablish natural riparian systems, including vegetative filter strips and streambank vegetation.

b. Develop riparian restoration projects.

c. Promote wetland construction to assimilate nutrient loadings.

Buffer Initiative Program - SCC

a. Install grass buffer strips near streams.

b. Leverage Conservation Reserve Enhancement Program to hold riparian land out of production.

Extension Outreach and Technical Assistance - Kansas State University

a. Educate agricultural producers on sediment, nutrient, and pasture management.

b. Educate livestock producers on livestock waste management and manure applications and nutrient management planning.

c. Provide technical assistance on livestock waste management systems and nutrient management plans.

d. Provide technical assistance on buffer strip design and minimizing cropland runoff.

e. Encourage annual soil testing to determine capacity of field to hold phosphorus.

Time Frame for Implementation: Pollutant reduction practices should be installed within the priority subwatersheds during the years 2002-2006, with minor followup implementation, including other subwatersheds over 2006-2010.

Targeted Participants: Primary participants for implementation will be agricultural producers and urban and suburban residents within the drainage of the lake.

Milestone for 2006: The year 2006 marks the midpoint of the ten-year implementation window for

the watershed. At that point in time, sampled data from Hillsdale Lake should indicate evidence of reduced phosphorus and chlorophyl a levels in the conservation pool elevations relative to the conditions seen over 1987-2000. Improved average Secchi disk depth should also be noted, particularly in the Big Bull arm of the lake.

Delivery Agents: The primary delivery agents for program participation will be the Hillsdale Water Quality Project, conservation districts for programs of the State Conservation Commission and the Natural Resources Conservation Service. Producer outreach and awareness will be delivered by Kansas State Extension and the Hillsdale Water Quality Project.

Reasonable Assurances:

Authorities: The following authorities may be used to direct activities in the watershed to reduce pollutants.

1. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.

2. K.S.A. 2-1915 empowers the State Conservation Commission to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.

3. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control nonpoint source pollution.

4. K.S.A. 82a-901, et seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.

5. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan.*

6. The *Kansas Water Plan* and the Marais des Cygnes Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

Funding: The State Water Plan Fund annually generates $16-18 million and is the primary funding mechanism for implementing water quality protection and pollutant reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to programs supporting water quality protection. This watershed and its TMDL are a High Priority consideration.

Effectiveness: Nutrient control has been proven effective through conservation tillage, contour farming and use of grass waterways and buffer strips. The key to success will be widespread utilization of conservation farming within the watersheds cited in this TMDL.

6. MONITORING

The KDHE Lake Monitoring Program intends to sample Hillsdale Lake annually. The Army Corps of Engineers will monitor annually as well. The U.S. Army Corps of Engineers and the Kansas Department of Wildlife and Parks will obtain summertime Secchi Disc depth readings in the main body and arms of the lake, noting periods when storm runoff creates turbid conditions beyond that associated with in-lake biological populations.

7. FEEDBACK

Public Meetings: A public meeting to discuss TMDLs in the Marais des Cygnes Basin was held on February 28, 2001 in Ottawa. An active Internet Web site was established at http://www.kdhe.state.ks.us/tmdl/ to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Marais des Cygnes Basin.

Public Hearings: Public Hearings on the TMDLs of the Marais des Cygnes Basin were held in Fort Scott on May 30 and Ottawa on May 31, 2001.

Basin Advisory Committee: The Marais des Cygnes Basin Advisory Committee met to discuss the TMDLs in the basin on October 4, 2000, February 28, 2001, and May 30, 2001 .

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:

Hillsdale Water Quality Project (http://www.birch.net/~HWQP/):
September 18, 2000; October 16, 2000; January 18, 2001; and June 14, 2001
Municipal: February 20, 2001

Milestone Evaluation: In 2006, evaluation will be made as to the degree of implementation which has occurred within the watershed and current condition of Hillsdale Lake. Subsequent decisions will be made regarding the revisions to the wasteload and load allocations, implementation approach, and follow up of additional implementation in the watershed.

Consideration for 303(d) Delisting: The lake will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process: Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2002 which will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2002-2006.

Bibliography for Hillsdale Lake

Barnes, Philip. Hillsdale Lake Source Assessment of Sediment and Phosphorus Water Quality Impairments. Kansas State University. 2000

Bright, Jared, and Jason A. Manczuk. An Estimation of the Annual Loading of Total Phosphorus into Hillsdale Lake, 1994-1999. Hillsdale Water Quality Project, Inc. August 2000.

Carney, C. Edward. Bioassay Results for Hillsdale Lake. Kansas Department of Health and Environment. October 1999.

Carney, C. Edward. Bioassay Results for Hillsdale Lake. Kansas Department of Health and Environment. September 2000.

Carney, C. Edward. Hillsdale Lake Nutrient Loading Study for Total Maximum Daily Load (TMDL) Development. Kansas Department of Health and Environment. August 1994.

Carney, C. Edward. Lake and Wetland Monitoring Program Report. Kansas Department of Health and Environment. 1997.

Carney, C. Edward. Requested information on the two TMDL "review themes" you received from EPA which relate to lakes [Memorandum] 5 Aug. 1999

Herzfeld, Mark, et. al. Bull Creek Watershed Population and Land Use Projections. Johnson County Planning Office. 1991.

Jones, John R. Evaluation of the Limnology of Hillsdale Lake, Kansas. Columbia, MO. June 1998.

Juracek, Kyle E. Analysis of Bottom Sediment to Estimate Nonpoint-Source Phosphorus Loads for 1981-96 in Hillsdale Lake, Northeast Kansas. U.S. Geological Survey. 1997.

Liscek, Bonnie C. Reference for Determining Limitation/Co-Limitation of Nutrients [Memorandum] 18 Jun. 2001

Mau, David P., and Victoria Christensen. Comparison of Sediment Deposition in Reservoirs of Four

Kansas Watersheds. U.S. Geological Survey. August 2000.

Palos, Dean, et. al. Hillsdale Lake Watershed Population and Land Use Projection, 1990-2010, for the Hillsdale Lake Nutrient Study. Johnson County Planning Office. October 1990.

Putnam, James E. Occurrence of Phosphorus, Other Nutrients, and Triazine Herbicides in Water from the Hillsdale Lake Basin, Northeast Kansas, May 1994 Through May 1995. U.S. Geological Survey. 1997.

Stiles, Thomas C. Rationale and Reference to Selected TMDL Issues [Memorandum] 6 Aug. 1999

United States. EPA Region 7 and Hillsdale Lake Water Quality Project. Summary of Monitoring Results Hillsdale Lake Water Quality Project 1993 - 1996. Kansas City: State of Kansas, July 1997.

United States. Kansas Department of Health and Environment. A Study of Nutrient Loading and Its Potential Effect on Water Quality in Hillsdale Lake. Topeka: State of Kansas, February 1987.

United States. Kansas Water Office. Hillsdale Lake Yield Analysis Report. Topeka: State of Kansas, July 2000.

United States. United States Department of Agriculture. Big Bull Creek Water Quality Incentive Project. Olathe: State of Kansas, 1992.

United States. Hillsdale Water Quality Project. Sampling Plan for Hillsdale Lake Tributaries. New Century: State of Kansas, 1995/1996, 1997/1998, 1998/1999, 1999/2000, and 2000/2001.

APPENDIX A

The Waste Load Allocation goal is 27.8 pounds per day from all point sources (10,147.84 lb/year divided by 365 days/year). For the total 1.86 MGD NPDES permitted discharges, an equal concentration allocation of 1.79 mg/L will meet this goal, as shown in the table below.

Initial wasteload allocations to individual dischargers might look as shown in the following table. However, actual allocations among dischargers will be determined by the Municipal and Industrial Programs of KDHE and subject to public review via public notice of the individual discharger's NPDES permit at time of renewal. While the individual allocations are likely to be altered from those indicated within the table, the total Wasteload Allocation will be 27.8 pounds per day.

Tentative Wasteload Allocation

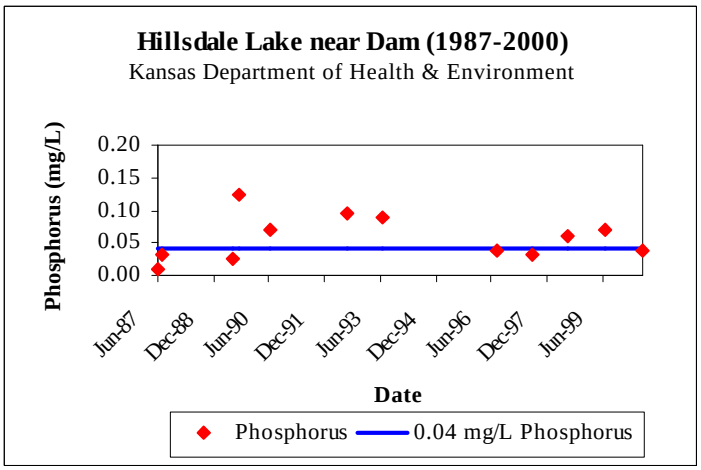
Name	Design Flow (MGD)	Final Total Phosphorus Concentration (mg/L)	Load (lb/day)
Gardner WTF (South)	0.988	1.79	14.77
Gardner WTF (temporary)	0.288	Temporary	*N/A
Conestoga Mobile Home Park WTF	0.030	1.79	0.45
Edgerton WTP	0.180	1.79	2.69
Circle C Ranch	0.011	Non-discharging	N/A
New Century Air Center combined with Lone Elm Estates	0.662	1.79	9.89
		Total (lb/day)	**27.80**

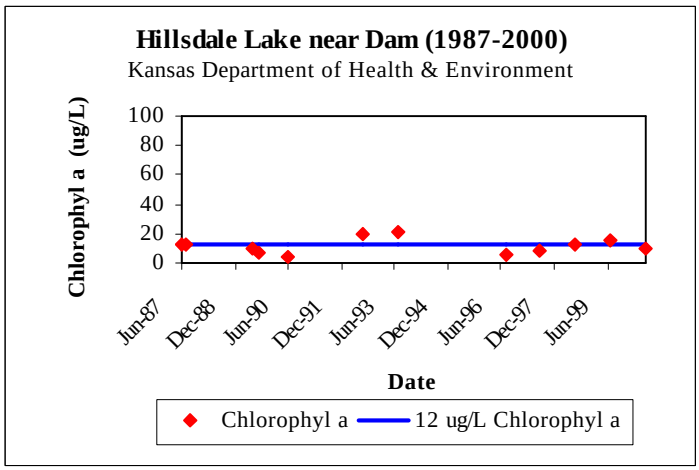
*Temporary, not included in total

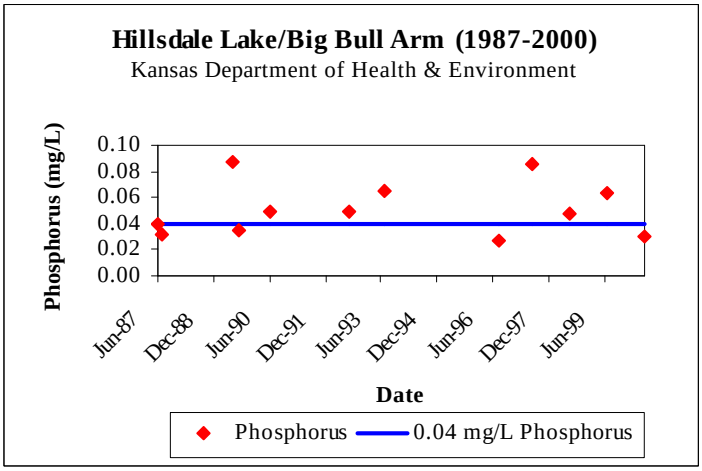
This initial allocation is consistent with current allocations permitted for New Century Air Center. In actuality, the Air Center and Lone Elm Estates are anticipated to continue the present pattern of actually discharging far less load than indicated by this allocation. Gardner will likely need to reduce phosphorus levels in its discharge and upgrades for this treatment plant might be made concurrently with present plans to upgrades to meet final ammonia limits. Edgerton is undergoing an upgrade for disinfection of fecal bacteria. Consideration should be made for opportunities to reduce future phosphorus loads as well at the treatment plant.

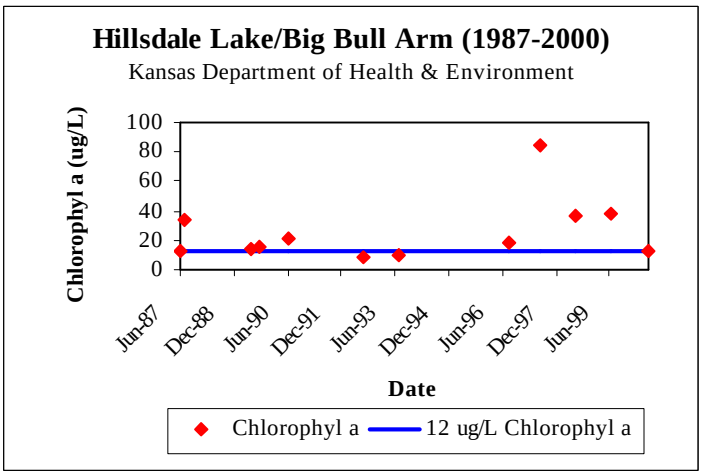
These wasteload allocations will be subject to review and revision by the Bureau of Water, KDHE on a five-year cycle consistent with NPDES permit renewal. Revisions will consider current loadings, potential growth in loading, potential new dischargers in the watershed and reductions in nonpoint source loadings. Opportunities to trade load allocations among point sources and between point source and nonpoint sources will be considered during each revision at the time of permit renewal.

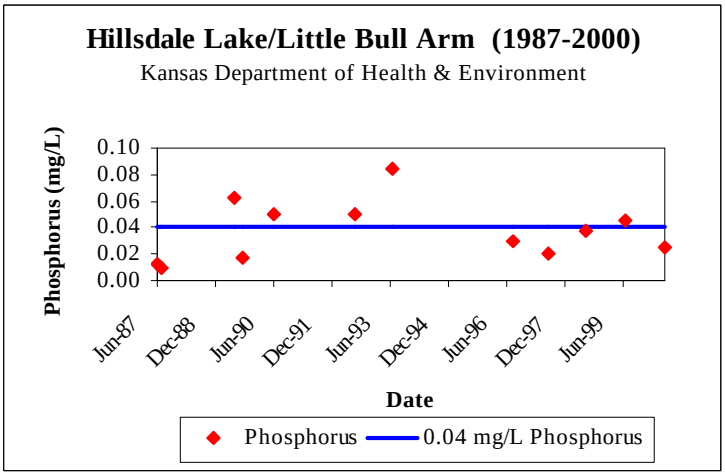
APPENDIX B

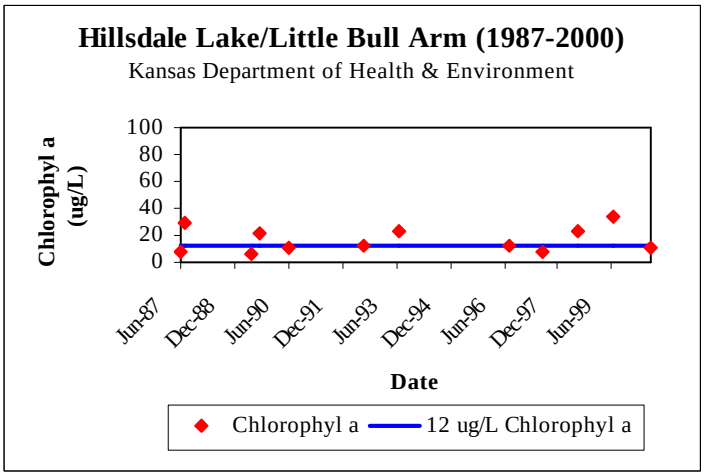

Hillsdale Lake near Dam (1987-2000)
Kansas Department of Health & Environment
Phosphorus (mg/L)
0.20
0.15
0.10
0.05
0.00
Jun-87
Dec-88
Jun-90
Dec-91
Jun-93
Dec-94
Jun-96
Dec-97
Jun-99
Date
Phosphorus
0.04 mg/L Phosphorus

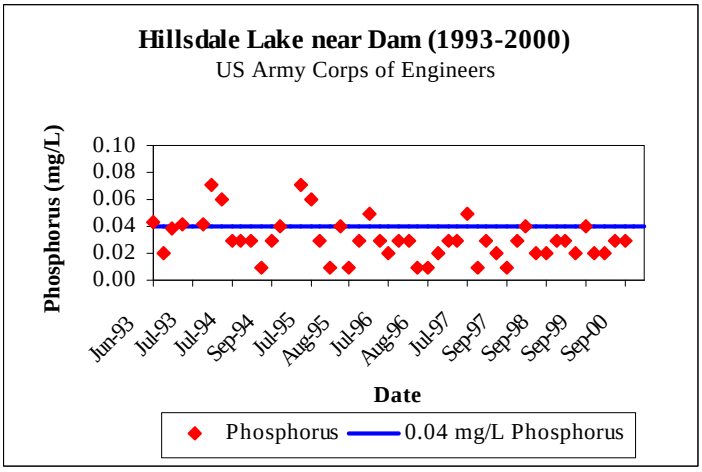

Hillsdale Lake near Dam (1987-2000)
Kansas Department of Health & Environment
Chlorophyl a (ug/L)
100
80
60
40
20
0
Jun-87
Dec-88
Jun-90
Dec-91
Jun-93
Dec-94
Jun-96
Dec-97
Jun-99
Date
Chlorophyl a
12 ug/L Chlorophyl a

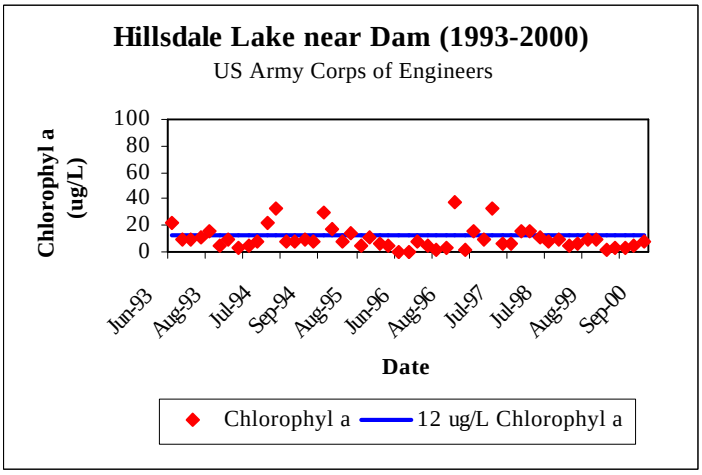

Hillsdale Lake/Big Bull Arm (1987-2000)
Kansas Department of Health & Environment
Phosphorus (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Jun-87
Dec-88
Jun-90
Dec-91
Jun-93
Dec-94
Jun-96
Dec-97
Jun-99
Date
Phosphorus
0.04 mg/L Phosphorus

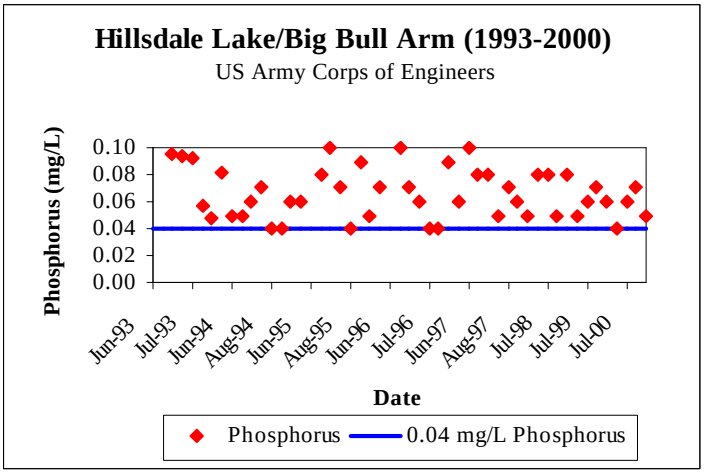

Hillsdale Lake/Big Bull Arm (1987-2000)
Kansas Department of Health & Environment
Chlorophyl a (ug/L)
100
80
60
40
20
0
Jun-87
Dec-88
Jun-90
Dec-91
Jun-93
Dec-94
Jun-96
Dec-97
Jun-99
Date
Chlorophyl a
12 ug/L Chlorophyl a

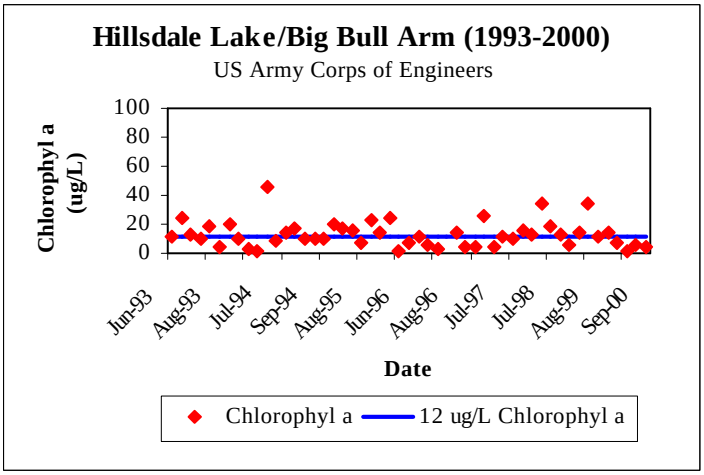

Hillsdale Lake/Little Bull Arm (1987-2000)
Kansas Department of Health & Environment
Phosphorus (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Jun-87
Dec-88
Jun-90
Dec-91
Jun-93
Dec-94
Jun-96
Dec-97
Jun-99
Date
Phosphorus
0.04 mg/L Phosphorus

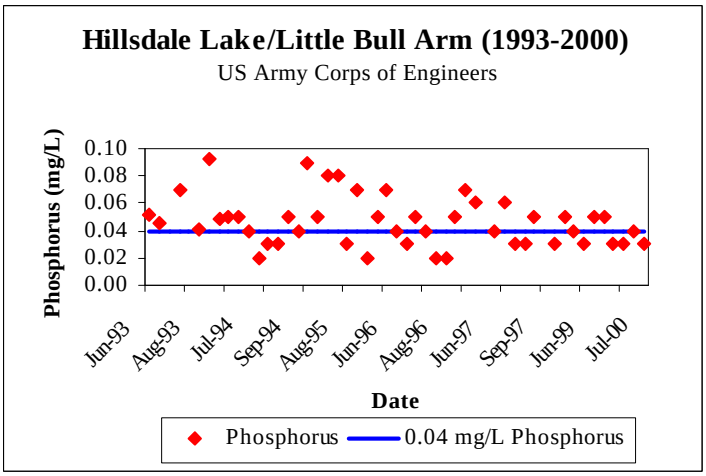

Hillsdale Lake/Little Bull Arm (1987-2000)
Kansas Department of Health & Environment
Chlorophyl a (ug/L)
100
80
60
40
20
0
Jun-87
Dec-88
Jun-90
Dec-91
Jun-93
Dec-94
Jun-96
Dec-97
Jun-99
Date
Chlorophyl a
12 ug/L Chlorophyl a

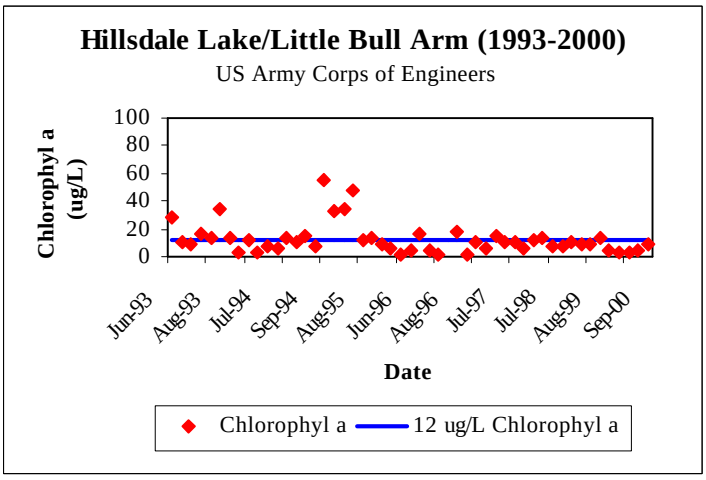

Hillsdale Lake near Dam (1993-2000)
US Army Corps of Engineers
Phosphorus (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Jun-93
Jul-93
Jul-94
Sep-94
Jul-95
Aug-95
Jul-96
Aug-96
Jul-97
Sep-97
Sep-98
Sep-99
Sep-00
Date
Phosphorus
0.04 mg/L Phosphorus


Hillsdale Lake near Dam (1993-2000)
US Army Corps of Engineers
Chlorophyl a (ug/L)
100
80
60
40
20
0
Jun-93
Aug-93
Jul-94
Sep-94
Aug-95
Jun-96
Aug-96
Jul-97
Jul-98
Aug-99
Sep-00
Date
Chlorophyl a
12 ug/L Chlorophyl a


Hillsdale Lake/Big Bull Arm (1993-2000)
US Army Corps of Engineers
Phosphorus (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Jun-93
Jul-93
Jun-94
Aug-94
Jun-95
Aug-95
Jun-96
Jul-96
Jun-97
Aug-97
Jul-98
Jul-99
Jul-00
Date
Phosphorus
0.04 mg/L Phosphorus


Hillsdale Lake/Big Bull Arm (1993-2000)
US Army Corps of Engineers
Chlorophyl a (ug/L)
100
80
60
40
20
0
Jun-93
Aug-93
Jul-94
Sep-94
Aug-95
Jun-96
Aug-96
Jul-97
Jul-98
Aug-99
Sep-00
Date
Chlorophyl a
12 ug/L Chlorophyl a


Hillsdale Lake/Little Bull Arm (1993-2000)
US Army Corps of Engineers
Phosphorus (mg/L)
0.10
0.08
0.06
0.04
0.02
0.00
Jun-93
Aug-93
Jul-94
Sep-94
Aug-95
Jun-96
Aug-96
Jun-97
Sep-97
Jun-99
Jul-00
Date
Phosphorus
0.04 mg/L Phosphorus


Hillsdale Lake/Little Bull Arm (1993-2000)
US Army Corps of Engineers
Chlorophyl a (ug/L)
100
80
60
40
20
0
Jun-93
Aug-93
Jul-94
Sep-94
Aug-95
Jun-96
Aug-96
Jul-97
Jul-98
Aug-99
Sep-00
Date
Chlorophyl a
12 ug/L Chlorophyl a